

SOME SCIENTIFIC CENTRES.

V.—THE CHEMICAL LABORATORY OF THE ROYAL INSTITUTION

THE record of the chemical laboratory of the Royal Institution is such as to give it an unique position among laboratories. The Royal Institution was established in Albemarle Street, London, in 1800, and had its origin in the work Count Rumford did for the poor at Munich—in fact, it first came into existence, in 1799, as the Rumford Institution. We are told that “its primary objects were models, workshops, and useful knowledge to benefit the poor ; and that lectures, researches and scientific experiments to amuse and interest the rich, and to advance science, were comparatively the secondary intention of its founder”—and yet the advancement of science has always been its chief function, and it is safe to say that no other single institution has so brilliant a record of successes. But we have only to think of Davy's invention of the safety lamp and of Faraday's electrical researches—of which the modern dynamo and electric traction are an outcome—to realise that, as a matter of fact, the researches carried out in the laboratory of the Institution have served, in the most direct manner possible, to benefit the poor and to carry out Rumford's true purpose, and this, too, in a manner and with a completeness which he could never have contemplated as in the least degree possible. It has proved to be, not merely “a public institution for diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements”—but the birthplace of discoveries which have given rise to them.

Writing from the Royal Institution to his daughter in March, 1801, Rumford said :—“We have found a nice able man for this place as lecturer [on chemistry], Humphrey Davy.” A few years later he was able to speak of Davy as the man “who by his eloquence and genius saved the Rumford Institution from an early death.” Davy did far more than lecture—from the outset he gave to the Institution its policy, by making it the home of research, and set an example of which it is impossible to exaggerate the importance. Davy was appointed in February, 1801. Volta had just made his great discovery ; as Davy phrases it, “the voltaic battery was an alarm bell to experimenters in every part of Europe.” Nicholson and Carlisle made the discovery of the decomposition of water by the pile on April 30, 1800. Davy was at once attracted to the study of galvanism, and he treated of galvanic phenomena in his first course of lectures. The closing paragraph of the series of extracts from this course, published in vol. i. of the *Journal of the Royal Institution* under the date September 1, 1801, is a happy forecast of the victories to be won by himself and others in the field of galvanism :—

“But independent of the immediate applications of this science, much is to be hoped from the elucidations which it may bestow upon the kindred sciences. And a discovery so important as to excite our astonishment cannot fail of becoming at some period useful to society. All the different branches of human knowledge are intimately connected together, and theoretical improvements cannot well be made in them without being accompanied by practical advantages.”

Davy's initial triumph in this field was won in 1806, when he delivered the Bakerian lecture, “On some Chemical Agencies of Electricity.” The fact that the Institute of France awarded him for this the prize founded by Napoleon for the most important discovery in galvanism, at a time when England and France were at war, is clear proof of the importance attached to his work by the scientific opinion of the time. In the following year came the great discovery of the alkali metals which immortalised his name. It is fair to say that previous

workers had made but chance discoveries, but that Davy's work was clearly based on theory ; in fact, that it laid the first theoretical foundations of electrochemical science. Davy laid great stress on the interdependence of chemical and electrical phenomena. Faraday, his successor, fully established by his researches their quantitative interrelationship, and formulated the laws which to the present day serve to guide us. The importance of these researches to chemical theory was dwelt on by Helmholtz, in 1881, in the Faraday memorial lecture which he delivered to the fellows of the Chemical Society in the theatre of the Royal Institution. The conception of valency as consequent on atomic charges of electricity deduced from Faraday's researches, to which Helmholtz directed attention, has yet to be fully appreciated. The closing years of the century, we know, witnessed a remarkable development of electrochemical theory at the hands of Arrhenius and Van 't Hoff ; whether the hypothesis applied by these two philosophers be essentially true or not matters little—it is sufficient that it has made the mathematical discussion of chemical phenomena possible, with a degree of accuracy and to an extent altogether remarkable. Modern electrochemical theory, however, is largely based on the discoveries made in the chemical laboratory of the Royal Institution, and this may well be regarded as the original home of both pure and applied electrochemical science.

Davy was both professor of chemistry and director of the laboratory ; when Brande followed him as professor, Faraday became director of the laboratory and later on Fullerian professor of chemistry. Faraday's chemical work has never been sufficiently appreciated, his electrical researches having overshadowed it. The skill displayed in his organic researches would do credit to a well-trained chemist at the present day—and yet he was self-trained in such work and there were no precedents to guide him. From this point of view, on account of its completeness, the memoir in which the discovery of benzene was described by him in 1825 is altogether remarkable. The modern chemist thinks only of Kekulé in connection with benzene, but if the hexagon be the appropriate symbol to put on the shield of Kekulé's memory, its shadow should at least hover in the atmosphere of the Royal Institution laboratory—especially as the present occupant of the Fullerian chair has won the right to have it put on his hatchment with nitrogen substituted for carbon at one of the angles. In discovering benzene, Faraday laid the foundation-stone of the coal-tar colour industry. A second most important contribution to this industry was made by him in 1826 by the discovery of sulphonaphthalic acid. We rarely think of him as the father of sulphonic acids, or as the progenitor of the naphthols and the madder colours. No one would have rejoiced more than Faraday over a wondrous story such as can now be told of benzene—*i.e.* the manner in which a large part of organic chemistry centres around it, and of the way in which with its aid the colour-producing power of Nature has been altogether outdone.

Faraday's work on the condensation of the gases will always stand unrivalled on account of the originality and simplicity of his methods and of its completeness ; its influence, we know, has been world-wide.

At the beginning of his career at the Royal Institution, Davy turned his attention to agricultural chemistry. He was in consequence engaged by the Board of Agriculture, in 1802, to deliver a course of lectures to its members on the connection of chemistry with vegetable physiology. This he continued to do for ten years, and he thus laid the foundation of agricultural science in this country. Had so wise a proceeding been continued, agriculture might well have been in a far better position than it now is.

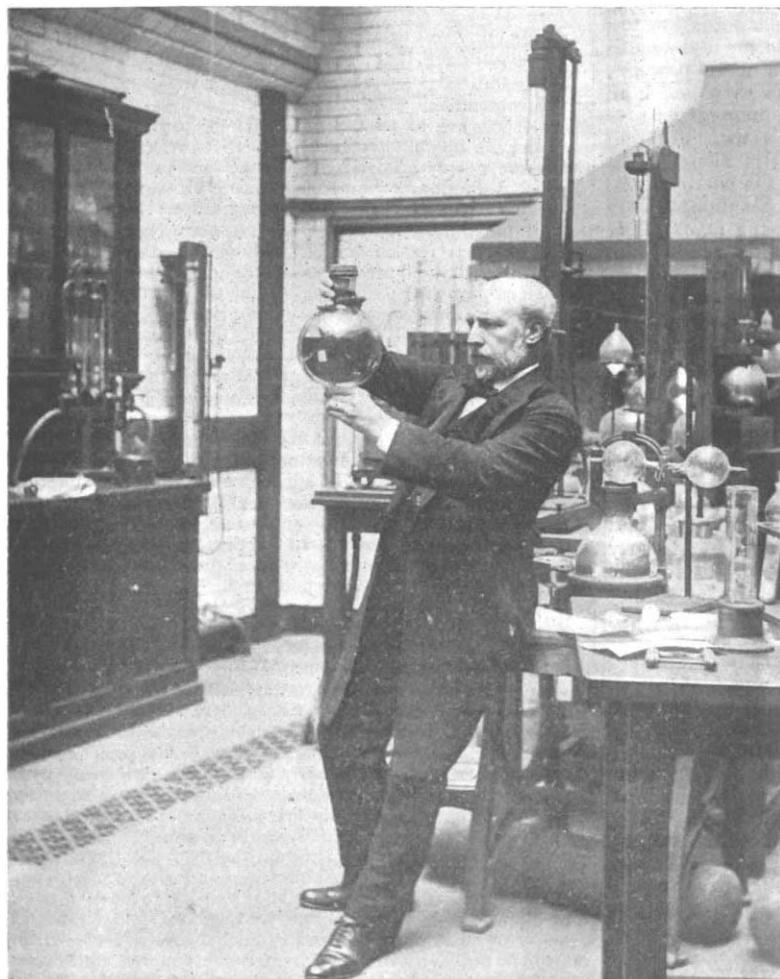
Faraday also had technical proclivities, as shown by

his researches on the alloys of steel and on the manufacture of optical glass. Had the example he set in the Royal Institution laboratory been followed, we should scarcely now be making the armour plates for our iron-clads under license from Krupp, or be obliged to resort to Jena for improved qualities of glass.

Brande, who occupied the chair in succession to Davy, from 1813 to 1852, did little in the way of research work. Faraday's star was brightest throughout most of these years, and it would indeed have been remarkable had there been a second chemical luminary. It was during Brande's time that the attempt was made to establish a school of chemistry at the Institution which the late

received the consideration they deserve. In extension of this inquiry, he was led to investigate the influence of pressure on the emission of light ; among the important results he obtained was the observation that a considerable luminous effect was obtained by burning hydrogen in oxygen under pressure.

Prof. Dewar was appointed Fullerian professor in 1877. Those who have followed his career may recall the two Friday evening lectures he gave prior to his appointment, describing work which he and Prof. McKendrick had done on the effect of light on the retina and optic nerve ; the latter of these especially was a remarkable *tour de force*, exhibiting the facility of experimental resource and brilliance of demonstration which have ever since characterised Prof. Dewar's lectures and rendered them so peculiarly attractive and instructive. It should not be forgotten that he was the first to study the oxidation products of the quinoline bases. His earlier work at the Institution lay in a field far removed from that in which he has since acquired such distinction, and was carried out at high temperatures. The reversibility of the rays of metallic vapours, the origin and identification of spectra, and the synthetic changes effected in the electric arc occupied his attention at this time. Much of this work was done in conjunction with Prof. Living. Prof. Dewar entered the field of low-temperature research in the early eighties, and gradually the chemical laboratory of the Royal Institution has been transformed into a veritable machine shop. For years past liquid air has been handled there as though it were water, and researches have been systematically carried on at very low temperatures with the certainty and ease with which experiments are made in laboratories generally at ordinary temperatures. Our knowledge of the properties of matter at temperatures near to the absolute zero has consequently been developed to a remarkable extent. To quote the words used by the President of the Royal Society in 1894, with reference to his work on the liquefaction of gases, when handing to him the Rumford medal, Prof. Dewar "has displayed, not only marvellous manipulative skill and fertility of resource, but also great personal courage, such researches being attended with considerable danger. One of his chief objects has been so to improve and develop the



Prof. James Dewar, F.R.S.

Sir F. Abel referred to in the Hofmann memorial lecture as the movement which culminated in the foundation of the Royal College of Chemistry.

Frankland, who held the professorship of chemistry from 1863 to 1868, did some of his best work in the Institution laboratory, notably the research (in conjunction with Dupper) on the action of sodium (followed by that of methyl or ethyl iodide) on acetic ether, which has since proved to be one of the most fruitful of synthetic methods. In the course of lectures on coal gas which he delivered in 1867—fully reported at the time in the *Journal of Gas Lighting*, but not otherwise published—he advanced novel views on the origin of flame which have not yet

methods of liquefying the more permanent gases that it shall become possible to deal with large quantities of liquid, and to use such liquids as instruments of research in extending our knowledge of the general behaviour of substances at very low temperatures. In this he has already been highly successful. Not only has he succeeded in preparing large quantities of liquid oxygen, but he has been able by the device of vacuum-jacketed vessels to store this liquid under atmospheric pressure during long intervals, and thus to use it as a cooling agent."

The vacuum vessels here referred to were introduced into use by Prof. Dewar in 1892, and have contributed in an extraordinary degree to the advancement of research

at low temperatures. Without them, the crowning achievement of obtaining hydrogen in the liquid state (May, 1898) would scarcely have been possible. Prof. Dewar is shown handling one of these vessels in the picture on p. 461.

The researches carried out under the transcendental conditions now available at the Royal Institution have led to many surprises : notably is this true of the investigations carried out by Profs. Dewar and Fleming on the electrical conductivity of metals, and on specific inductive capacity. The fact that almost all substances may be rendered phosphorescent by insulation when cooled to low temperatures is another discovery made by Prof. Dewar which promises to be of special importance in the light of recent researches on radio-activity.

But to understand Prof. Dewar fully, it is necessary to know him in the upper as well as in the lower regions of the Royal Institution ; not only the wealth of his powers of imagination and his scientific acumen then become apparent, but it is realised that he is a man of extraordinarily sympathetic nature, penetrated with artistic feeling and emotions. Unfortunately, he is also gifted with a reticence rare among artists, which is particularly manifest when the time comes to commit his thoughts to paper ; the world has lost much in not being made fully acquainted with his discoveries, and if his reflections were more frequently uttered outside his private circle, it would be to the advantage of scientific progress. We may hope that there is much time left to him in which to repair minor faults such as these.

A laboratory in which so many remarkable and important discoveries have been made may certainly be said to have justified the hopes of its founder, and it is surprising that its successes have not won for it a larger measure of public support—that as yet it has had no imitators.

But there is one respect in which Count Rumford might well deplore failure. However much the lectures delivered in the Institution may have interested and even amused the rich, they have failed to lead them to appreciate in any proper measure the value of scientific research to the nation, a subject on which Davy dwelt much in his lectures ; for had they done so, an industry such as the coal-tar colour industry, so closely connected in its origin with the Institution, which was first established and for a time flourished in this country, would not have been allowed to pass almost entirely into other hands ; the attempt made by Davy to raise agriculture to a science would have been persevered in at the public cost ; electrochemistry would have been steadily developed ; and pioneer work such as Faraday did on iron and glass would not have been allowed to stand in splendid isolation. A century of the highest example has had little effect in making the knowledge of scientific method a public possession.

THE BELFAST MEETING OF THE BRITISH ASSOCIATION.

IN previous issues of NATURE, particulars have been given as to the local arrangements which have been made for the comfort of those attending this meeting, and the titles of the papers which may be expected to be read in the various sections have been published ; not much remains, therefore, to be said by us on this occasion. It may, however, be stated that the illustrated handbook or guide issued by the Association and prepared under the auspices of the Belfast Naturalists' Field Club appears to have been very carefully compiled. It deals with the subjects respectively of Belfast, geology, botany, zoology and antiquities, and is the work of many writers. So far as can be seen as we go to press, the meeting will be a successful one, it being estimated that in point of numbers attending it

will equal the gathering of 1874, at which the total attendance was 1951. Given fine weather, the meeting should be no less enjoyable and interesting than many of its predecessors. It had been hoped that the *Scotia*, of the Scottish Antarctic Expedition, would have been able to visit the harbour and be open for inspection by the members of the Association ; this hope, however, seems likely to be disappointed. The address of the President, Prof. Dewar, was delivered as we went to press yesterday, and the various sections began their proceedings this morning. In this issue we print the Presidential Address and that of the President of Section A. Other addresses and accounts of the papers and reports brought before the sections will duly appear in subsequent numbers.

INAUGURAL ADDRESS BY PROF. JAMES DEWAR, M.A., LL.D., D.Sc., F.R.S., PRESIDENT OF THE ASSOCIATION.

THE members of an Association whose studies involve perpetual contemplation of settled law and ordered evolution, whose objects are to seek patiently for the truth of things and to extend the dominion of man over the forces of nature, are even more deeply pledged than other men to loyalty to the Crown and the Constitution which procure for them the essential conditions of calm security and social stability. I am confident that I express the sentiments of all now before me when I say that to our loyal respect for his high office we add a warmer feeling of loyalty and attachment to the person of our Gracious Sovereign. It is the peculiar felicity of the British Association that, since its foundation seventy-one years ago, it has always been easy and natural to cherish both these sentiments, which indeed can never be dissociated without peril. At this, our second meeting held under the present reign, these sentiments are realised all the more vividly, because, in common with the whole empire, we have recently passed through a period of acute apprehension, followed by the uplifting of a national deliverance. The splendid and imposing coronation ceremony which took place just a month ago was rendered doubly impressive both for the King and his people by the universal consciousness that it was also a service of thanksgiving for escape from imminent peril. In offering to His Majesty our most hearty congratulations upon his singularly rapid recovery from a dangerous illness, we rejoice to think that the nation has received gratifying evidence of the vigour of his constitution, and may, with confidence more assured than before, pray that he may have length of happy and prosperous days. No one in his wide dominions is more competent than the King to realise how much he owes, not only to the skill of his surgeons, but also to the equipment which has been placed in their hands as the combined result of scientific investigation in many and diverse directions. He has already displayed a profound and sagacious interest in the discovery of methods for dealing with some of the most intractable maladies that still baffle scientific penetration ; nor can we doubt that this interest extends to other forms of scientific investigation, more directly connected with the amelioration of the lot of the healthy than with the relief of the sick. Heredity imposes obligations and also confers aptitude for their discharge. If His Majesty's royal mother throughout her long and benevolent reign set him a splendid example of devotion to the burdensome labours of State which must necessarily absorb the chief part of his energies, his father no less clearly indicated the great part he may play in the encouragement of science. Intelligent appreciation of scientific work and needs is not less but more necessary in the highest quarters to-day than it was forty-three years ago, when His Royal Highness the Prince Consort brought the matter before this Association in the following memorable passage in his Presidential Address : "We may be justified, however, in hoping that by the gradual diffusion of science and its increasing recognition as a principal part of our national education, the public in general, no less than the legislature and the State, will more and more recognise the claims of science to their attention ; so that it may no longer require the begging box, but speak to the State like a favoured child to its parent, sure of its paternal solicitude for its welfare ; that the State will recognise in science one of its elements of strength and prosperity, to protect which the clearest dictates of self-interest demand." Had this advice been seriously taken to heart and acted upon by the rulers of the nation at the time, what splendid